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PATENT APPLICATION  
TITLE: PORTABLE TABLE

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BACKGROUND

The present invention relates to portable tables, and more particularly to portable tables having foldable table frames supporting a readily disassembled table top, wherein the table frame can be quickly and easily folded into a compact unit for storage and unfolded for use in one motion, and wherein the table top can be quickly assembled for mounting on the frame and quickly disassembled for storage with the frame.

Portable tables find use in a variety of situations, including camping and like applications where tables are often not provided as permanent fixtures of the camp site. Historically, early portable tables were one piece, tabletop and frame, commonly known as "card" tables. Typically, the table was made of a non-bending rigid material, usually metal, with legs which fold underneath and into the table. The problem with such conventional table is that the table is bulky, usually rather heavy, and difficult to carry. Also, because the table frame is limited to four vertical legs, either the whole unit was heavy and was of limited portability, or was light weight and not very sturdy. Also, with this type of conventional portable table, because the table top does not disconnect from the frame, e.g. the legs, a conventional portable table of the aforementioned type cannot fold up to be easily transportable in a typical consumer's vehicle.

As a result, the next generation of table development was to provide a table frame and table top of greater portability. One way in which this objective was pursued was by constructing a separate portable table top and a separate portable table frame. Available such portable table frames are collapsible, so that they are easily transported. Such conventional portable frames are made up of several parts, having to be disassembled for transport or storage, and having to be reassembled for use. Such portable table frames must be assembled for use out of several parts. Thus, the legs of the table, along with support arms for supporting the table top must be screwed or locked together when the table is set up, and then taken apart when the table frame is to be put away. Also, typically, the table top support arms each extend the full length of the needed support under the table top, accordingly limiting portability of the frame.

The current generation of portable table frames can be opened and closed in a single easy motion, has a structure which provides strong support for a portable table

top, folds into a compact configuration for easy storage, and avoids the risk of losing parts, or parts not fitting over time, as a result of having a one-piece structure. However, such one-piece structures are comprised of many parts. Representative of such table frames and table tops are US Patent 6,158,361 Zheng et al, issued  
5 December 12, 2000, and US Patent 6,234,089 Zheng et al issued May 22, 2001, both of which are incorporated herein by reference in their entireties, to the extent compatible with the teachings of the present invention, for their teachings of frame structure and table top structure. Each part, of course, comes with an attendant cost, and with an attendant risk of structural failure. Accordingly, it would be desirable to  
10 provide such portable table frames which are easily set up and closed while reducing the number of parts required in the frame structure, and while providing desired levels of strength in the frame.

As with frames for portable tables, table tops have also evolved with time. Just as frame technology has advanced so as to provide a frame which is easily set up and taken down, so, too, has the table top been developed to fit respective frames.  
15 However, existing table tops are either too large and bulky to be practical to use, or too light and weak to bear weights of 100 pounds or more which can be desired in e.g. a camping use.

Thus, it would be desirable to provide table top structures wherein the number of parts is limited, wherein the table top can readily be made more compact in at least one dimension and wherein the strength of the table top is such that a distributed load of at least 100 pounds can be tolerated without jeopardizing the integrity of the table.  
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SUMMARY

This invention provides improved table tops, and frames, for collapsible tables. The table top comprises multiple, relatively rigid plastic leaf elements which interlock with each other to make the table top, and pull apart for storage. The leaf elements are typically injection molded, or otherwise fabricated as unitary elements of the table top, and are effective for assembly to each other without intervening assembly elements. The leaf elements are preferably color coded so as to assist in arrangement of the leaf elements with respect to each other when the table top is assembled.

The frames all include two pairs of support arms underlying the table top. Loads and other forces from the table top pass through the support arms and thence to an underlying frame body. The invention comprehends improved structure for supporting the support arms from the frame, and improved structure for passing the loads and other forces to the frame body, as well as improved structure for guiding and controlling movement of the support arms when the frame is collapsed for storage or transport.

In a first set of embodiments, the invention comprehends a table top having a plurality of leaf elements detachably connected to each other and lying in side by side relationship with respect to each other to form a generally continuous upper surface of the table top. The table top has a length, and a width. Each leaf element has a length, and respective first and second side edges, extending along the width of the table top, and a width, and respective third and fourth opposing end edges, extending along the length of the table top. The plurality of leaf elements comprises, in combination, interface structure on ones of the leaf elements for mounting the table top to a compatible table frame. Each leaf element further comprises at least one of a connector tab or a connector receptacle slot, disposed at an intermediate location on at least one of the first and second side edges. Each leaf element further comprises at least two of end tabs and/or receptacle end slots, disposed adjacent the opposing end edges thereof. The combination of the connector tabs in the connector receptacle slots and the end tabs in the end receptacle slots comprises tab-connector combinations which are effective to releasably join the leaf elements together in forming the generally continuous upper surface. Accordingly, a force imposed on one leaf element, including at an end edge, can be transferred to an adjacent one leaf element through one or more of the respective tab-connector combinations.

In preferred embodiments, end leaf elements have a first side edge bearing the tabs and slots and a second side edge free from the tabs and slots, and intermediate leaf elements have first and second opposing side edges both bearing the tabs and slots.

5 In preferred embodiments, the end leaf elements and the intermediate leaf elements are color coded to distinguish the end leaf elements from the intermediate leaf elements, whereby the end leaf elements can readily be visually distinguished from the intermediate leaf elements, thereby to assist in assembly of the table top.

10 In some embodiments, the invention comprehends a table top having a plurality of leaf elements lying in side by side relationship with respect to each other, and joined to each other, to form a generally continuous upper surface of the table top, the table top having a length, and a width, each leaf element having a length, and respective first and second side edges, extending along the width of the table top, and a width, and respective third and fourth opposing end edges, extending along the length of the table top. The plurality of leaf elements comprise, in combination, interface structure on ones of the leaf elements for mounting the table top to a compatible table frame. Each leaf element further comprises structure assisting in effecting the joinder of the leaf elements to each other in side by side relationship. End leaf elements and intermediate leaf elements are color coded to distinguish the end leaf elements from the intermediate leaf elements, whereby the end leaf elements can readily be visually distinguished from the intermediate leaf elements, thereby to assist in assembling the table top.

25 In some embodiments the invention comprehends a collapsible table frame for supporting a compatible table top thereon. The table frame comprises a collapsible table frame body; first and second pairs of frame top joints mounted for pivotation with respect to a top of the collapsible table frame body; and first and second table top support arm assemblies. Each table top support arm assembly comprises a pair of table top support arms, first and second table top support arm holders, a support arm pillar for supporting the respective table top support arm holders, and a pin connecting the table top support arm holders to each other and to the support arm pillar. Each table top support arm on the respective table top support arm assembly has an outward end extending away from the support arm pillar and an inward end

proximate the support arm pillar, at least one of the support arms on each top support arm assembly comprising a flange proximate the inward end of the respective support arm, whereby when the table frame is set up, the flange abuts the respective support arm holder.

5 In some embodiments, the inward ends of each pair of table top support arms extend inwardly to slidably connect through respective ones of the table top support arm holders of the table top support arm assemblies, wherein when the table frame is fully erected, the two support arms in each pair of table top support arms are parallel to each other and the respective support arms in the pair, in combination, extend in  
10 a generally straight line between respective ones of the frame joints, and wherein bottom ends of the two support arm pillars are mounted for pivotation with respect to the collapsible table frame body.

15 In some embodiments the table top support arm holders are mounted for pivotation with respect to the respective support arm pillar thereby to enable the table top support arms to slide through the table top support arm holders.

20 In some embodiments, in order to collapse the collapsible table frame, each table top support arm slides through a respective table top support arm holder inwardly and toward a respective top joint, and rotates about a frame top joint such that the inward end of the respective table top support arm moves downward, with the table top support arm holders in each table support assembly rotating in opposite directions as the respective table top support arms rotate and slide inwardly and downwardly to a downward position as the table frame is collapsed.

25 In some embodiments, in order to erect the collapsible table frame, each table top support arm rotates about a frame top joint such that the inward end thereof moves upward and the support arm slides through a respective table top support arm holder away from a respective top joint, with the table top support arm holders in each table support assembly rotating in opposite directions as the respective table top support arms slide outwardly and upwardly as the table frame is erected, sliding movement of the table top support arms being susceptible of being arrested by the  
30 flanges as the table frame reaches a fully erected configuration.

In yet other embodiments, the invention comprehends a collapsible table frame for supporting a compatible table top thereon. The table frame comprises a collapsible table frame body; first and second pairs of frame top joints mounted for pivotation

with respect to a top of the collapsible table frame body; and first and second table top support arm assemblies. Each table top support arm assembly comprises a pair of table top support arms, a support arm pillar for supporting the respective table top support arm holders, and a pin connecting the top support arms to each other and to the support arm pillar. Each table top support arm on the respective table top support arm assembly has an outward end extending away from the support arm pillar and an inward end proximate the support arm pillar. The support arm pillar comprises a slot having a top. The slot has a top, and a length extending downwardly from the top to a bottom of the slot. The pin extends through the pillar at the slot. The slot further comprises a hook at the top thereof, whereby when the table frame is set up, the pin rises in the slot to a position adjacent the hook so that the hook can be moved transverse to the length of the pillar and thus moved under the pin, thus to provide support to the pin and thus to the support arms while the frame is in the set up configuration.

In preferred embodiments, the hook has a downward ramp at the bottom edge thereof, so gravity or downward force on the support arms urges the pin to stay in the hook until such time as the load or other force is retracted.

In other embodiments, the invention comprehends a collapsible table. The table comprises a collapsible table frame for supporting a compatible table top thereon; a table top comprising a plurality of leaf elements detachably connected to each other in serial edge-to-edge relationship to form a generally continuous upper surface of the table top. The table top has first and second ends, and opposing side edges extending between the first and second ends. The table top, when assembled, comprises flanges extending downwardly from respective loci inwardly of the first and second ends of the table top and interfacing with the table frame so as to attach the table top to the table frame.

In preferred embodiments, the flanges comprise apertures therethrough. The frame comprises support arms having studs extending into and through the apertures in the flanges, and extending outwardly from the apertures beyond the flanges.

In highly preferred embodiments, the studs are extended outwardly as the frame is set up, so as to extend through the apertures in the flanges, and retract through the apertures as an inherent function of collapsing the frame.

5 The invention also comprehends methods of assembling a table top to a collapsible table support frame. The method comprises substantially erecting the collapsible table support frame, including extending opposing table top support arms of a table top support arm assembly; positioning the opposing table top support arms a small distance inward from a fully erected configuration; aligning a compatible table top, having mounting flanges extending downwardly from a bottom of the table top, with outer ends of the table top support arms; and extending the table top support arms into assembling engagement with the mounting flanges on the table top and thereby fully erecting the collapsible table support frame as the table top is being assembled to the table support frame.

10 In some embodiments, the flanges comprise apertures, and the method includes extending end portions of the support arms into and through the apertures such that the end portions extend outwardly from the apertures when the table is fully assembled.

15 In other embodiments, the invention comprehends a collapsible table frame for supporting a compatible table top thereon. The table frame comprises a collapsible table frame body comprising first and second pairs of side legs and third and fourth pairs of front and rear legs. The legs in each pair of legs are mounted for pivotation with respect to each other so as to cross while pivoting with respect to each other. Each of the third and fourth pairs of legs are joined to each of the first and second pairs of legs. The frame further comprises first, second, third, and fourth frame top joints which define upwardly disposed portions of the collapsible table frame body, mounted for pivotation with respect to ones of the front, side, and rear legs. The frame still further comprises first and second table top support arm assemblies. Each table top support arm assembly comprises a pair of table top support arms. Each table top support arm has an outward end disposed toward the respective top joint, and an inward end. The inward ends of the table top support arms are pivotally connected to each other at a pivot joint. The frame yet further comprises a locking elbow bracket extending from the pivot joint to a respective one of the side legs between the respective top joint and the pivot locus of the respective pair of side legs.

25 In some embodiments, the locking elbow defines an acute angle of at least about 40 degrees, preferably at least about 45 degrees, more preferably about 50 degrees to about 70 degrees, and most preferably about 60 degrees, with respect to



one of the support arms in the respective support arm assembly when the table frame is fully erected and the locking elbow bracket is locked.

In yet other embodiments, the invention comprehends a collapsible table frame for supporting a compatible table top. The table frame comprises a collapsible table frame body; first and second pairs of frame top joints mounted for pivotation with respect to a top of the collapsible table frame body; and first and second of table top support arm assemblies. Each table top support arm assembly comprises a pair of table top support arms, first and second table top support arm holders, and a support arm pillar for supporting the respective table top support arm holders. Each table top support arm has an outward end extending away from the support arm pillar and an inward end proximate the support arm pillar, and including first and second slots on opposing sides of each support arm, extending from a first slot end proximate the inward end of the respective support arm, and extending toward the outward end. Each table top support arm assembly further comprises a pin connecting the support arm holders to each other and to the support arm pillar, and extending through the slots in the support arms, whereby when the table frame is set up, the slots are adjacent the pin at the first slot ends.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 shows a pictorial view of a table of the invention, including collapsible support frame and a table top assembled to the collapsible support frame.

FIGURE 2 shows a pictorial view of the collapsible support frame of the table of FIGURE 1, without showing the table top.

FIGURE 3 shows a plan view of the collapsible support frame of FIGURE 2, with the table top superimposed in dashed outline on the support frame.

FIGURE 3A shows a fragmentary pictorial view of a pair of table top support arms in respective support arm holders, supported by a support arm pillar, wherein the support frame is in a fully erected configuration.

FIGURE 3B shows a side elevation view of the collapsible support frame of FIGURE 2 in a partially collapsed, partially erect configuration.

FIGURE 4 shows a side elevation view of a second embodiment of the collapsible support frame.

FIGURE 4A shows a top fragmentary view of the table top support arms of the embodiment of FIGURE 4, illustrating the pin extending through both support arms.

FIGURE 5 is a top view of the table top, with part of the top surface cut away to show reinforcing structure of the table top, and with one leaf element displaced to show interaction of the tabs and slots in assembly of the leaf elements in assembling the table top.

FIGURE 5A is an end elevation view of the table top of FIGURE 5, showing the flanges extending downwardly for engagement with the table top support arms of the support frame.

FIGURE 6 is a side elevation view of a third embodiment of the collapsible support frame, including an elbow brace on each side of the support frame, and extending from a pivot joint between the table top support arms to an underlying side leg of the support frame.

FIGURE 6A shows a side elevation view of the embodiment of FIGURE 6A, fully collapsed.

FIGURE 7 is a side elevation view of a fourth embodiment of the collapsible support frame, including a modified pillar on each side of the support frame.

FIGURE 7A shows a side elevation view of the embodiment of FIGURE 7, partially collapsed.

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The invention is not limited in its application to the details of construction or the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in other various ways. Also, it is to be understood that the terminology and phraseology employed herein is for purpose of description and illustration and should not be regarded as limiting. Like reference numerals are used to indicate like components.

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DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Referring to FIGURES 1, 2, 3, 3A, and 3B, a foldable table frame 10 of the invention comprises first and second table support arm assemblies 12, and four support arm assembly joints 14. Table frame 10 includes first and second pairs of side legs 18S and third and fourth pairs of front and rear legs 18F and 18R. Four leg connectors such as pins 20, or alternately rivets, connect the legs in each respective pair of legs to each other so as to enable a crossing relationship between respective legs in each pair of legs. The frame 10 further includes four base pads 22. Lower ends of legs 18 are mounted for pivotation to respective ones of the base pads.

Each table support assembly 12 includes first and second table top support arms 24, first and second table top support arm holders 26, and an upstanding support arm pillar 28. The support arm holders and pillar 28 are connected to each other by a pin 29, or alternately a rivet, at a central joint 31 adjacent the top end of the support arm pillar, connecting each of the support arm holders to an inner side of the top end of the support arm pillar, such that the support arm holders can pivot about pin 29 with respect to the support arm pillar. Support arm pillar 28 is mounted adjacent a lower end thereof to the respective pair of side legs 18S by the respective pin 20, for pivotation with respect to the legs.

Frame 10 includes two pairs of table top support arms 24. Each table top support arm 24 of each pair has an outward end 30 displaced from support pillar 28 and an inward end 32 adjacent support pillar 28. Each support arm 24 is pivotally connected to a respective joint 14 at an intermediate locus 34 between the inward and outward ends of the arm. Each support arm 24 is slidably received in one of support arm holders 26 adjacent the inward end of the support arm. The inward end of each support arm is flared as indicated at 36, such that the support arm holder is between the flared portion of the support arm and the outward end of the support arm. While the flared portion of the support arm need not be at the distal inward end of the support arm, such distal location is preferred for economy of use of materials. In general, that portion of the length of the support arm which bears force applied by an overlying table top resides between the flare and the outward end of the support arm.

Flared end 36 can extend the full circumference of the support arm 24, or any portion of such circumference which is effective to provide the abutment functions discussed hereinafter. Thus, the flare can be intermittent, or can consist of a single

tab, or can consist of multiple tabs. In any event, the flared portion of a support arm is an integral part of the support arm itself, thus eliminating any need for any abutment element to be mounted to the end of the support arm for the purpose of abutting the support arm holder thus to limit movement of the support arms when the frame is set up.

In the context of the above description, each support arm of a given pair of table top support arms is slidably received in a respective support arm holder. When the frame is fully erected, each support arm is disposed in parallel relationship with the other support arm of the respective pair of support arms, and each pair of support arms is disposed above a pair of frame side legs 18S. The outward end of each table top support arm 24 extends outwardly beyond the assembly top joints 14. At the outward end of each table top support arm is a table top connector 38. Connector 38, as illustrated, has a round cross-section stud 39 for insertion into a round opening in the table top. Stud 39 could as well have any cross-section configuration which is compatible with insertion into a cooperating opening in the table top.

Support arm pillar 28 strengthens the table top support arms, transferring force on the support arms downward to the respective pin 20, and from pin 20 to the respective side legs 18S, and through the side legs 18S to base pads 22. Thus, when a table top is placed on and connected to the frame so as to transfer force from the table top to the table top support arms, pillar 28 is a primary avenue for transferring such force from the table top to the base pads.

As shown in e.g. FIGURE 2, each pair of legs 18 is pivotally connected together by the respective pivot pin 20, at the mid-point of each leg, thus to form a structure wherein the legs in each pair of legs cross each other at essentially the mid-point of the respective legs. Accordingly, when the foldable table frame is in an open, erected configuration, the four pairs of table frame legs 18 extend at diagonals to the support arms, in crossing relationship with each other. As shown in e.g. FIGURE 3, the four pairs of legs 18 form a square projection on an underlying surface. Each of legs 18 is connected at a top end thereof to a top joint 14, and at a bottom end thereof to a base pad 22. There are, therefore, four frame top joints 14 and four base pads 22, as shown in FIGURE 2, with the top joints and base pads being located at respective corners of the square configuration formed by the four pairs of table frame legs 18 in the open erected configuration of the frame.

Each of the frame base pads 22, thus, connects to a first or second table frame leg 18 of one pair of the legs, and connects to a second or first table frame leg 18, respectively, of an adjoining pair of the legs, such that each table frame leg 18 can pivot around the connection between the respective leg 18 and the respective base pad 22 to which such leg is connected, such pivoting being effected along the respective imaginary planes generally containing respective ones of the pairs of legs 18, as the foldable frame is opened and closed.

Each frame top joint 14 is connected to upper ends of the two legs of adjoining pairs of legs which do not connect to the frame base pad 22 directly below the respective frame top joint 14. For example, if a first table frame leg 18 connects at its lower end to a frame base pad 22, then the upper end of the second frame leg 18 of the same pair connects to the frame top joint 14 which is directly above the respective base pad.

FIGURE 3B shows the table frame in the process of being closed from the open and erect configuration. As the table frame is closed, the legs 18 in a given pair of legs pivot in a scissors-line manner with respect to each other about pins 20 which extend through, and thus connect, the respective pairs of legs. For each support arm assembly 12, the support arms 24 pivotally fold downward as the frame is being closed, collapsed to its reduced volume configuration. As the support arms fold downward, the respective support arm holders, in which the support arms are received, pivot about the respective pin 29 such that the ends of the support arm holders which face toward inward ends 32 of the support arms move downwardly in combination with the downward movement of the inward ends of the support arms, and the ends of the support arm holders which face outward ends 30 of the support arms move upwardly in combination with the upward movement of the outward ends of the support arms. Accordingly, the support arm holders at each support arm assembly rotate in opposite directions as the frame is being closed, collapsed. Similarly, the support arm holders at each support arm assembly rotate in opposite directions as the frame is being set up, erected, albeit directions which are the reverse of those extant when the frame is being closed, collapsed.

Further to the collapse, closure of frame 10, support arms 24 slide in the support arm holders, with the outward ends of the arms sliding toward the support arm holders, and conversely, with the inward ends of the arms sliding away from the support arm holders. FIGURE 3B illustrates the frame in a partially closed, collapsed

configuration. FIGURE 6A, although a different embodiment, illustrates generically a frame of the invention in a fully closed, collapsed configuration. As illustrated in FIGURES 3B and 6A, as frame 10 is in the process of collapsing, the perimeter of the frame, as defined by the legs, shrinks and the height is extended, as legs 18 rotate in a scissors-line manner, narrowing the cross structure of each crossing pair of legs to a near parallel relationship.

Similarly, when the frame is being set up, erected, arms 24 slide in opposite directions to those described for closure of the frame. Thus, when the frame is being set up, the outward ends 30 of arms 24 slide away from the support arm holders and the inward ends 32 of arms 24 slide toward the support arm holders. As the support arms slide outwardly through the support arm holders, flared ends 36 of the support arms approach the facing ends of the respective support arm holders.

The lengths of the support arms, and the corresponding locations of the flared portions of the arms, are selected such that the surface of a flared end comes into abutting relationship with the facing end of the respective support arm holder at approximately the same time as the arms come into a parallel relationship with each other.

In general, and as described hereinafter, as the table top exerts force on the underlying frame, to the extent a force is applied from the table top downwardly on the frame, the application of such force urges the respective pairs of support arms into the above described parallel relationship with each other. Thus, the locations of the flares on the support arms is permissive of the support arms in a given pair coming into full parallel relationship with each other.

However, the flare locations on the arms can be such that the arms can come into full parallel relationship with each other without the flares reaching abutment with the support arm holders. In such situation, stopping sliding movement of the support arms in the support arm holders as the frame is set up is a function of the relationships of the support arms with respect to the legs and the support arm holders. Namely, as the support arms approach a relationship parallel with each other, downward set-up force applied to the frame is resisted by the changing configuration of the frame members such that expansion of the frame perimeter tends to stop when the support arms reach their parallel configuration.

Some additional further expansion of at least the upper frame perimeter can be achieved, in combination with further rotating of support arms 24 beyond their parallel

relationship. However, such further expansion is not desired, and so is generally not practiced.

In such instance of the flares not reaching abutment when the support arms reach a parallel relationship, the function of the flared portion of a given support arm is to operate as a fail safe structure to prevent the arms from inadvertently continuing to move outwardly through the support arm holders by excessive distances, thus preventing inward ends of the support arms from passing completely through and out of the support arm holders. In this embodiment, the flared portions are not in abutment with the support arm holders, indeed they are spaced from the support arm holders, when the support arms are in parallel relationship as the frame is fully set up, erected.

The ends of the support arm holders facing the flared portions of the support arms rotate upwardly with the support arms. The perimeter of the frame, as defined by the four pairs of legs, expands.

FIGURES 1, 5, and 5A illustrate table tops 40 useful in portable tables of the invention. The table top 40 as illustrated in assembled configuration in FIGURES 1, 5, and 5A has a length "L1", a width "W1", a generally continuous upper surface 42, left and right side edges 44, and front and rear end edges 46. Table top 40 also has a bottom including a plurality of downwardly extending interconnected ribs 47, and two spaced flanges 49 on either end for releasably interconnecting the table top to the underlying frame 10.

As shown in FIGURE 5, the table top is defined by four leaf elements 48A, 48B, 48C, and 48D. Each leaf element has a length "L2" extending along the width of the table top and a width "W2" extending along the length of the table top. Each leaf element has side edges 50 extending along the length "L2", and end edges 51 extending along the width "W2". End leaf elements 48A and 48D have generally unbroken side edges 50 at the respective end edges 46 of the table. The opposing side edge 50 of each of leaf elements 48A and 48D defines a connector tab 52 and a connector slot 54.

Edges of leaf elements 48B and 48C which face the edges of leaf elements 48A and 48D have cooperating connector tabs 52 and connector slots 54 in alignment with respective slots and tabs on leaf elements 48A and 48D. Similarly, the edges of the leaf elements 48B and 48C which face each other include cooperating connector tabs and connector slots.



The tabs and slots on the respective leaf elements are in alignment with respective tabs and slots on adjacent leaf elements such that a tab on one leaf element can be inserted into a slot in an adjacent leaf element for joining the leaf elements together in assembling the table top. The cooperating connector tabs 52 and slots 54, which are intermediate the ends of the respective leaf elements, include cooperating male retainers 56 and female receptacles 58 which engage as the tabs are engaged in the slots, to temporarily retain the tabs in engagement with the slots. Retainers 56 and receptacles 58 are optional, though preferred. The retainers can be on either of the tabs or slots, with the receptacles on the other of the tabs or slots. In preferred embodiments, male retainers are disposed on bottom surfaces of the connector tabs and female receptacles are disposed at facing surfaces of the respective cooperating slots. A preferred receptacle is a through aperture which extends from the respective interior surface of the slot through the entire thickness of the material which forms the interior surface of the slot, and to the outside environment.

Connector tabs 52 and connector slots 54 are of sufficient length and width to effectively transfer anticipated forces, applied to the upper surface of the table top, at locations intermediate the ends of the table top, from a first leaf element to a second leaf element. Accordingly, e.g. load forces on the upper surface of the table top are effectively transferred and shared from a leaf element where the force is applied to or resident in an adjacent leaf element at locations intermediate the lengths of the leaf elements and at locations between the underlying support arms 26 which interact with and directly support the table top at the bottom surface of the table top. Thus, a force applied to or resident in leaf element 48B toward the middle of the length of the leaf element can be transferred to both of adjacent leaf elements 48A and 48C through the adjoining connector tabs 52 and slots 54. Similarly, residual portions of such force can potentially be transferred from leaf element 48C to leaf element 48D through the respective connecting tabs and slots. Such sharing of the load by the leaf elements is a critical feature of the table top in order to optimize the load bearing capacity of the table top.

An important feature of the invention is the ability of the table top to bear a high capacity load away from the support arms. In that regard, material selection is important. Since the leaf elements are to lock together at tabs 52 and slots 54, thermoplastics are a preferred class of material. Among the thermoplastics, a number of materials are known for their toughness and resistance to structural abuse. There

can be mentioned, for example and without limitation, polyamides, certain of the high density polyethylenes, and acrylonitrile butadiene styrene (ABS) copolymers. Any thermoplastic material which meets the desired strength characteristics can be used. ABS is preferred for its cost/strength ratio, in combination with its desirable processing properties.

Returning to the structure of the table top, each leaf element includes a top sheet 51 forming the generally continuous top surface of the table top, and a network of the interconnected ribs 47 extending downwardly from the top sheet, and thus serving to reinforce the top loading strength of the top sheet. The ability of the table top to share portions of the load across leaf elements, by transferring such loads through tabs 52 and slots 54, further enhances the ability of the table top to bear substantial loads.

Still addressing the structure of the table top, and the cooperation of the leaf elements with each other, each leaf element includes an edge tab 60 or edge slot 61 on respective ones of the side edges 50 adjacent each of the end edges 53 of the respective leaf element. Edge tabs and edge slots are not located at side edges 50 at the respective end edges of the table, whereby the side edges 50 at the respective end edges 46 of the table are typically free from all of tabs 52, slots 54, tabs 60, and slots 61.

Adjacent leaf elements include cooperating ones of the edge tabs and edge slots such that each pair of leaf elements includes a tab-slot combination at each respective end edge 51. By employing the edge tab-slot combination at the ends of respective leaf element interfaces, the leaf elements can be properly aligned with each other to form the generally continuous upper surface of the table top as the table top is assembled whereby the edge tabs and slots provide an alignment function. By so fixing the relative positions of the leaf elements, and thereby combining the leaf elements to each other at the end edges, the edge tab-slot combinations provide an additional venue for sharing, and thus transferring, loads across leaf element interfaces, thus using leaf elements, which do not directly receive the load, to bear and sustain a load applied to a given leaf element.

The respective leaf elements of table tops of the invention are typically molded as unitary structures including top sheet 51, ribs 53, and flanges 49. Thus, table tops of the invention draw strength from, among other factors and without limitation, material selection; reinforcing ribs 47; the interconnectivity of the top sheet 51, the

ribs 53, and the flanges 49; and the interconnectivity and interlocking of the leaf elements with each other whereby a given leaf element shares loads with adjacent leaf elements.

Addressing specifically FIGURES 5 and 5A, flanges 49 extend downwardly as part of the table top. Each flange includes an aperture 62. Flanges 49 extend downwardly below ribs 47 sufficient distances to interface with studs 39 of the frame when the frame is fully erected. Preferably, flanges 49 abut the top sheet of the table top and are molded as integral extensions of the top sheet and a respective rib 47.

Table top 40 has a thickness "T" including both the thickness of the table top sheet and the depth of ribs 47. Ribs 47 form an interconnected matrix which extends over substantially the entirety of the projected area of the bottom surface 63 of the top sheet. The interconnection of ribs 47 with each other at loci directly over support arms 24 precludes positioning aperture 62 so as to engage stud 39 above the bottom surfaces of the ribs. Accordingly, flanges 49 extend downwardly below the bottom edges of ribs 47 by an amount sufficient to provide for inserting a stud 39 into the respective aperture while the respective support arm is oriented parallel to the bottom edges of ribs 47. Accordingly, flanges 49 extend downwardly from the respective bottom edges of the ribs.

In order to provide positive engagement of stud 39 with aperture 62, it is desirable to have stud 39 extend a substantial distance into and through aperture 62, so as to control any tendency for the stud to inadvertently pull out of the aperture while the table is in use. Accordingly, flanges 49 are positioned inwardly from the end edges of the table top, and studs 39 are designed and configured so as to extend substantially through the apertures with a snug transverse fit, and thus substantially through the flanges, with substantial length of a stud extending outwardly from the respective aperture toward the distal end of the stud. Thus, the flange is preferably mounted on a rib which is displaced from the end edge of the table top such that the stud can extend completely through the flange, and can extend thence outwardly from the flange, without extending beyond the end edge of the table top.

FIGURES 4 and 4A illustrate a second embodiment of frames 10 of the invention. As illustrated in FIGURES 4 and 4A, support arms 24 are devoid of flared end portions 36. Rather, the support arms have elongate slots 64 in sides of the support arms. And whereas pins 29 do not extend through support arms 24 in the embodiments of, for example, FIGURES 1, 2, and 3, in the embodiments of FIGURES

4 and 4A, pins 29 do extend through support arms 24 at slots 64. Thus, as illustrated in FIGURE 4A, pins 29 extend through pillar 22, through the full widths of support arm holders 26, and through the respective support arms 24 at slots 64.

When the table frame is set up as shown in FIGURE 4, slot 64 extends around pin 29 and thence toward the outward end of the support arm a sufficient distance to permissively enable the support arm to slide through the support arm holder without resistance from pin 29 when the frame is collapsed. The slot extends toward the inward end of the support arm a sufficient distance to permissively enable the support arm to slide through the support arm holder without resistance from pin 29 to such point as the frame is fully erected with the support arms parallel to each other as shown in FIGURE 4.

The inward end of slot 64 is positioned such that pin 29 abuts, or nearly abuts, the inward end of the slot when the frame is fully erected. Thus, in this embodiment, pin 29 operates to assist in stopping, or ensuring the stopping, of the sliding of the support arms at the desired location along the length of the support arms when the frame is erected. As with flared ends 36, the inward end of slot 64 can be positioned either so as to abut pin 29 when the frame is fully erect, or can be positioned so that pin 29 is proximate but not in abutment with the end of the slot when the frame is fully erect with the support arms in parallel configuration, whereupon the slot-pin combination provides a fail-safe feature to the frame set-up process which prevents support arms 24 from being overextended in the set-up process.

FIGURES 6 and 6A illustrate yet another embodiment of the invention. In the embodiment of FIGURES 6 and 6A, the support arms overlap in length at joint 31 only far enough to be joined by pin 29. An optional spacer (not shown) can be positioned between the support arms to facilitate rotation of the support arms with respect to each other. Support arm holders 26 are eliminated. The support arms do not slide with respect to each other. Rather the inward ends of the support arms are fixed in relation to each other, and jointly pivot with respect to pin 29.

An elbow brace 66 extends from each joint 31 downwardly to a respective underlying leg 18S. Each elbow brace 66 includes an upper arm 67U and a lower arm 67L, joined together by a pin 69 at an intermediate joint 72 of the brace. Upper and lower arms 67U and 67L have cooperating locking elements which become releasably engaged when the upper and lower arms come into a straight-line configuration as illustrated in FIGURE 6. The locking elements can be manually disengaged by applying

manual force at pivot joint 72 and thus urging the upper and lower arms out of their straight-line configuration, thus to collapse the brace to the configuration shown in FIGURE 6A while collapsing the remaining elements of the frame to the configuration shown in FIGURE 6A.

5 Pin 29, at each joint 31, extends through both support arms 24, the spacer if used, and a top end of the elbow brace. The bottom end of the elbow brace is mounted for pivotation about the respective underlying leg 18S by a pin 68 which extends through both the brace and the leg, at a bottom joint 70. Joint 70 can be positioned at any convenient location along the length of the respective leg 18S above  
10 pin 20. The purpose of brace 66 is to transfer, to the respective leg 18S, load forces applied to the support arms, especially load forces which reach the support arms at pin 29. Portions of such forces ultimately pass through pin 20 for transfer to the second leg in the respective pair of legs, whereby the forces extend to those portions of legs 18S, in the given pair of legs, which are below pin 20. Thus, the objective of elbow  
15 brace 66 is to transfer the force to leg 18S to facilitate transfer of the force to pin 20, and thence to the lower portions of both legs 18S of the pair. To that end, the elbow braces form acute angles " $\alpha$ " of at least about 40 degrees, preferably at least about 45 degrees, with the support arms when the frame is in the fully erect configuration, with the support arms parallel to each other, and with the elbow braces in the locked  
20 configuration shown in FIGURE 6. Preferred angles " $\alpha$ " for elbow braces 66 are about 50 degrees to about 70 degrees, with about 60 degrees being most preferred.

Set-up and take down of the frames of FIGURES 6 and 6A are similar to the set-up and take down of the frames discussed earlier, with the following changes. As with all embodiments, from the collapsed configuration illustrated in FIGURE 6A, one  
25 can pull outwardly on the outward ends of the support arms, thereby expanding the perimeter of the frame toward the fully erected configuration shown in FIGURE 6. Support arms 24 pivot about top joints 14 and central joints 31. The support arms of FIGURES 6 and 6A do not slide with respect to any holder. The elbow braces pivot about their intermediate joints 72, from the folded configurations shown in FIGURE 6A  
30 toward the straight-line configurations shown in FIGURE 6. As the frame approaches the fully erect configuration, the user manually pushes the elbow braces to the straight-line locked configuration shown in FIGURE 6, whereupon the frame is fully set up.

FIGURES 7 and 7A illustrate yet another embodiment of the invention. In the embodiment of FIGURES 7 and 7A, the support arms of the frame overlap in length at joint 31 only far enough to be joined by pin 29, as in FIGURES 6 and 6A. A modified pillar 28 is disposed between the support arms as in the embodiments of FIGURES 1, 2, and 3. Pillar 28, as shown, includes a slot 74. Referring to the frame as set up in FIGURE 7, slot 74 has a length "L3" (FIGURE 7A) extending from pin 29 at joint 31 to a point sufficiently low on pillar 28 to enable pin 29 to slide inside the slot while the support arms are rotating about pin 29 as the frame is collapsed for closure.

Slot 74 has a width "W3". Width "W3" is preferably generally constant along the length of the pillar from a top end to a bottom end. The top end of slot 74 includes a hook 76 illustrated in FIGURE 7A. Hook 76 extends transversely to the length of the slot and away from the long axis of the slot. A bottom surface of the hook extends downwardly as a downward ramp from the edge of the elongate portion of the slot, so gravity or downward force on the support arms urges pin 29 to stay in hook 76 until such time as the load or other force is retracted.

Optional spacers such as nylon washers (not shown) can be positioned between the support arms and the pillar to facilitate rotation of the support arms with respect to each other and with respect to the pillar. Support arm holders 26 are not used. The support arms do not slide with respect to each other. Rather the inward ends of the support arms are fixed in relation to each other, and jointly pivot with respect to pin 29 and with respect to each other. As the support arms pivot, the support arms and pin 29 slide along slot 74. For opening, erecting, and setting up the frame, pin 29 and support arms rise in the slot. When pin 29 reaches the top of slot 74, the user pushes transversely on the pillar so as to seat pin 29 in the hook of the slot. With the pin seated in hook 76, downwardly directed force imposed on the table top, and thus on the support arms and pin, is transferred through the pin to the pillar through the bottom of slot hook 76.

For closing and collapsing the frame, the user pushes pillar 28 transversely to the length of slot, moving the pillar such that the pin is forced out of the hook and into the main length run of the slot. The frame can then be collapsed, with pin 29 and support arms 24 moving downwardly in slot 74 as the frame is collapsed.

The embodiments of FIGURES 7 and 7A provide advantages of the strength of the vertical pillar of FIGURE 1 in combination with the simplicity and fewer parts at joint 31 of the embodiments of FIGURES 6 and 6A.

In view of the materials selection and structural configuration being compatible with high loading capacity, table tops of the invention are typically capable of bearing distributed loads of at least about 100 pounds. Load capacities as high as 200 pounds or more are contemplated.

In any of the embodiments of the invention, the table top is optionally assembled to the underlying frame, by extending the respective studs 39 on support arms 24 through the apertures 62 on the respective flanges 49 of the table top. After the table top is thus assembled to the frame, final erection of the frame is then effected. In those embodiments where the support arms slide through the support arm holders, such final erection can be accomplished by placing the thus assembled table on a e.g. horizontal surface and applying a modest amount of force, e.g. 10-20 pounds, on the table top. In those embodiments where the support arms do not slide through support arm holders, final erection of the frame is effected by locking the elbow braces in the straight-line configuration.

The table tops illustrated above are releasably affixed to the frames of the embodiments of FIGURES 4 and 6 in the same manner as such table tops are affixed to the frames of FIGURES 1, 2, and 3.

Referring to FIGURES 1 and 5, the leaf elements can be color coded to assist in assembly of the table top. As discussed above, end ones 48A and 48D of the leaf elements each have one side edge which bears the tabs 52 and 60, and the slots 54 and 61, and one side edge which is free from such tabs and slots. By contrast, intermediate leaf elements 48B and 48C have tabs and slots on both side edges. In addition, the end leaf elements bear flanges 49 while intermediate leaf elements bear no such flanges. Thus, the leaf elements must be properly selected and matched for compatibility for placement next to each other when the table top is assembled. Namely, the end leaf elements do not assemble properly as intermediate leaf elements and intermediate leaf elements do not assemble properly as end leaf elements. So relative ordering of the leaf elements with respect to each other is critical to proper assembly of the table top.

A desirable feature of this invention is to color code the leaf elements such that the end leaf elements are distinguishable from those leaf elements which do not form

an end edge of the table. By making such distinction by color, the user is immediately advised which leaf elements can successfully be placed edge to edge adjacent each other in assembling the table top. Thus, as illustrated in FIGURE 1, the end ones 48A and 48D of the leaf elements can be a first lighter color and the intermediate leaf elements 48B and 48C can be a second darker color. In the alternative, the end leaf elements can be a darker color and the intermediate leaf elements can be a lighter color. Still further, the colors need not be distinguished by light and dark characteristics, but can be distinguished by any easily recognized wave length difference of light emissions from the surface of the respective leaf elements.

Within the context of color identity of the end and intermediate elements, it is preferred that both end leaf elements be the same first color, and that the intermediate leaf elements be the same second color. However, it is not strictly necessary that the end leaf elements both be the same first color, or that the intermediate leaf elements all be the same second color, so long as readily distinguishing color patterns exist on the end and intermediate leaf elements.

For durability of color, the color is preferably molded in as part of the molded polymer composition.

While respective leaf elements are preferably distinguished by color in the polymer resin from which the leaf elements are molded, the leaf elements can be surface decorated by e.g. coatings, decals, and the like without losing such preferred, color-based, distinctions, so long as a substantial portion of the underlying polymer color can be readily distinguished about, beside, or through the surface decorations.

As an alternative to color coding, the end and intermediate leaf elements can be distinguished by surface texture differences which are preferably molded into the top surfaces of the respective leaf elements. Further, the inner and outer leaf elements can be distinguished by distinguishing markings such as letters, numbers, or other indicia or graphics or other marks which are molded into the leaf elements to thereby distinguish the end and intermediate leaf elements from each other.

Those skilled in the art will now see that certain modifications can be made to the apparatus and methods herein disclosed with respect to the illustrated embodiments, without departing from the spirit of the instant invention. And while the invention has been described above with respect to the preferred embodiments, it will be understood that the invention is adapted to numerous rearrangements,



modifications, and alterations, and all such arrangements, modifications, and alterations are intended to be within the scope of the appended claims.

To the extent the following claims use means plus function language, it is not meant to include there, or in the instant specification, anything not structurally  
5 equivalent to what is shown in the embodiments disclosed in the specification.

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